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# GRADING HARDWOOD LOGS
# FOR STANDARD LUMBER

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## Suggested Reading

1. Grade Defects in Hardwood Timber and Logs by C. R. Lockard, J. A. Putnam and R. D. Carpenter, Agriculture Handbook No. 244, U.S.D.A., Forest Service, 1963.

2. A Guide to Hardwood Log Grading (Revised) by M. D. Ostrander and others, U.S. Forest Service, Northeast Forest Experiment Station, Upper Darby, Pennsylvania, 1965.

3. Management and Inventory of Southern Hardwoods by J. A. Putnam, G. M. Furnival and J. S. McKnight, Agriculture Handbook 181, U.S.D.A., Forest Service, 1960.

4. Hardwood Log Grades for Standard Lumber by C. L. Vaughan, A. C. Wollin, K. A. McDonald and E. H. Bulgrin, FPL 63, U.S.D.A., Forest Service, Forest Products Laboratory, Madison, Wisconsin, 1966.

5. A Guide to Hardwood Log Grading (Revised) by Everette D. Rast, David L. Sonderman, Glenn L. Gammon, U.S.D.A., Forest Service, General Technical Report NE-1, 1973.

## Grading Hardwood Logs

Grading hardwood logs is *not* difficult. But it does require knowledge of defect indicators and close scrutiny to make sure no defects are overlooked. Most of the time the grade of a log can be determined while it is being scaled. The grade of most logs will be fairly apparent but, even in logs where this is not the case, it is seldom necessary to lay out the actual cuttings. Usually measurements to see if the cuttings conform to minimum size is enough to determine the grade.

### STEP 1

**Measurement of Log Diameter and Length**

Average diameter inside the bark on the small end of the log is used in scaling and grading. The length for figuring the necessary clear cuttings is dropped to the full foot, but cuttings are allowed to include the overlength.

## Faces

After measuring the log, the next step is to visually square the log full length into four faces so oriented to give the largest possible number of good faces. Confine any given defect to one grading face wherever possible instead of permitting it to extend over two faces unnecessarily. The grade of the log will be established by the poorest face of the best three faces. In other words, disregard the poorest face on the log, and grade the poorest of the remaining three faces. This is the grade of the log.

## STEP 3

### Clear Cuttings

The grade of a face is established on the basis of clear cutting requirements. Clear cuttings are portions of the length of the face that lie between defects or between the ends of the logs and defects, and extend the full width of the face.

Knots and bark-covered blemishes such as bumps, overgrown knots and grub holes are considered defects. However, any feature such as shallow scars, seams, and frost cracks which extend to a maximum depth of one-fifth or less the diameter of the log at that point is not considered a defect.
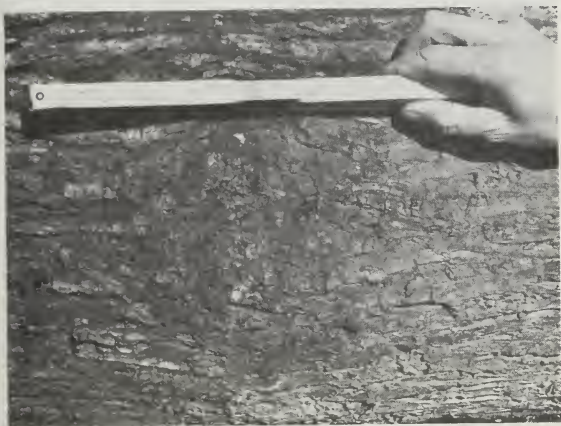
### Defects



Slight bark distortion, consisting of a simple horizontal break across the normal bark pattern - - *not* a defect.
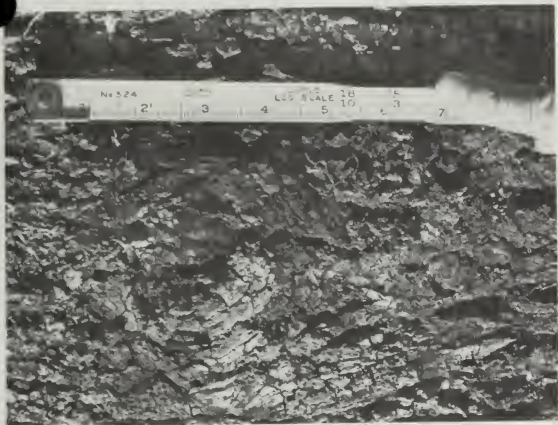
Medium bark distortion consisting of breaks across and along the normal bark pattern - - a defect in *all* diameter logs.



Small bark distortion, consisting of a break in the normal bark pattern but not clearly an overgrown knot - - not a defect in 15-inch and larger logs.

Bark distortion that clearly is an overgrown knot - - a defect in *all* diameter logs.



Adventitious twig growth 3/8" or less in diameter is a defect in logs under 14" d.i.b. On logs 14" and larger, only every other one is considered a defect. In the soft hardwoods it is not considered a defect in grade 3 logs.

Grub holes or other insect holes open or overgrown are defects on all logs under 16″ d.i.b.

On logs 16″ - 19″ d.i.b. - - disregard every 6th one.
On logs 20″ - 23″ d.i.b. - - disregard every 5th one.
On logs 24″ - 27″ d.i.b. - - disregard every 4th one.
On logs 28″ + d.i.b. - - disregard every 3rd one.

A bump is defined as any bark covered protuberance with gradual to abrupt sloping sides, the cause of which is not clearly evident.

Bumps are not considered defects in logs under 14″ d.i.b. when the length of the bump is 16 or more times its height. In logs 14″ d.i.b. and over, bumps are not considered defects when the length of the bump is 12 or more times its height.

A clear cutting may extend into both ends of bumps by 1/4 when length is 6 or more times the height-by 1/8 when length is 3 to 5 times the height.
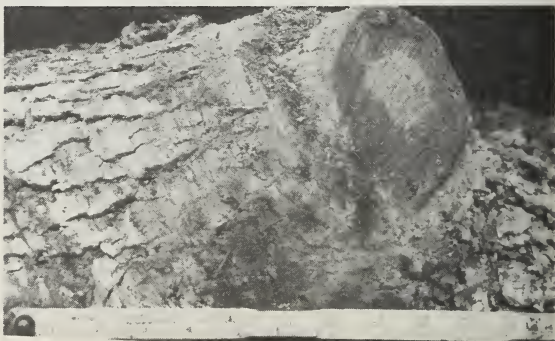
For measurement of clear cuttings adjacent to large coarse, elevated defects, the size of which is taken flush with the bark surface:

2″ - 4″ defects: cuttings may extend ½″ above flush bark surfaces.

5″ - 7″ defects: cuttings may extend 1″ above flush bark surfaces.

8″ + defects: cuttings may extend 1½″ above flush bark surfaces.

### End Defects

*Sound end defects,* such as medium to heavy mineral stain and slight dote on the small end of the log, shall not exceed 1/2 the log d.i.b. for grade 1 and grade 2 logs under 16″ d.i.b. and not exceed 3/5 the log diameter on grade 2 logs 16″ and larger. Over this amount, lower the log one grade. When the defect is not concentrated in one spot, its extent is taken as the sum of the individual occurrences. Slight stain is not a defect.

If *unsound end defects* such as decay and heavy shake extend more than 1/2 the distance between the heart zone and the bark, clear cuttings cannot be taken on the face overlying it. (The heart zone is 1/5 of the diameter measured from the pith.) If the defect extends less than full length of the log, however, cuttings can be taken over 1/3 of its estimated length from the end tapering out.

*Specific end defects* such as bird peck, wormholes, spot wormhole stain, mineral spots or streaks, and such unsound defects as grub holes and bark pockets must be considered when outside the heart zone. When these defects affect 1/2 the radial distance between the heart zone and the bark under three faces of the log at one end or two faces at both ends, a log grade 1 or 2 shall be reduced one grade. When there is less than 3 inches between the heart zone and the defect, or between defects, the portion will be included with the defect.

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## Forest Service standard specifications for hardwood factory lumber logs. (from FPL 63)

| Grading Factors | | Log Grades | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | F1 | | | F2 | | | | F3 |
| Position in tree | | Butts only | Butts & uppers | | Butts & uppers | | | | Butts & uppers |
| Diameter, scaling | | [1] 13"-15" | 16"-19" | 20" + | [2] 11" | 12" + | | | 8" + |
| Length without trim | | 10' + | | | 10'+ | 8-9' | 10-11 ' | 12' + | 8' + |
| Clear cuttings [3] on each 3 best faces | Length, min., | 7' | 5' | 3' | 3' | 3' | 3' | 3' | 2' |
| | Number, maximum | 2 | 2 | 2 | 2 | 2 | 2 | 3 | No limit |
| | Fraction of log length required in clear cutting [4] | 5/6 | 5/6 | 5/6 | 2/3 | 3/4 | 2/3 | 2/3 | 1/2 |
| Sweep and crook allowance (maximum) in percent gross volume | For logs with less than 1/4 of end in sound defects | 15% | | | 30% | | | | 50% |
| | For logs with more than 1/4 of end in sound defects | 10% | | | 20% | | | | 35% |
| Total scaling deduction including sweep and crook | | [5] 40% | | | [6] 50% | | | | 50% |
| End defects: | | See instructions Page 7 | | | | | | | |

[1] Ash and basswood butts can be 12 inches if they meet all other No. 1 requirements. [2] Ten-inch logs of all species can be No. 2 if they meet all other No. 1 requirements. [3] A clear cutting is a portion of a face free of defects, extending the width of the face. [4] See Table No.1 [5] Otherwise No. 1 logs with 41-60% deductions can be No. 2. [6] Otherwise No. 2 logs with 51-60% deductions can be No. 3.

**Bird peck defect**

Bird pecks are considered defects in cuttings of grade 1 and grade 2 logs when the area contains more than four bird pecks per square foot. However, when the depth of the bird peck on the end of the log is less than 1/10 of the log d.i.b., then it is not considered a defect.

If the depth of seams, frost cracks, and scars exceeds 1/5 d.i.b. but does not extend the full length of the log, clear cuttings can be taken over 1/3 of its length from the end tapering out.

## Sweep, Crook and Cull Deductions

If deductions in scale are made in excess of percentage allowed for each grade, the log is reduced one grade. All deductions that are made by enclosing the defect in a rectangle are computed by multiplying width (inches) + 1, height (inches) + 1, and length (feet) of the defect together and dividing by 15. The maximum percentage deduction for this type of cull as provided for in log grade specifications will apply to Scribner Decimal C, Doyle or International rules. However, when Doyle or International scale is used in grading, the percentage deduction should be multiplied by the following factors to give the approximate percentage deduction for grading:

|                      | *International* | *Doyle* |
|----------------------|-----------------|---------|
| Logs 8 - 14 inches   | 1.2             | 0.7     |
| Logs 15 - 20 inches  | 1.1             | 0.9     |
| Logs 21 + inches     | 1.0             | 1.0     |

The Forest Service scaling handbook can be used for making other types of scale deductions as can Grosenbaugh's rules. *(see Figure 1)*

## Yield of Clear Cuttings

Required yields are given in fractions for simplicity of application. For a 5/6 yield, use 10 times the nominal length of log in feet as equal to the required total clear length in inches. For example: for a 12 foot log, 10 x 12 = 120 inches or 10 feet required for a grade 1 face.

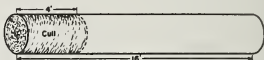For a 4/6 yield, use 8 x length; for 3/6, use 6 x length.

The amount permissible to *lose* can also be used, as Table 1 illustrates.

## METHODS OF DETERMINING SCALING DEDUCTION
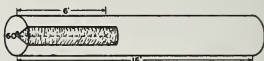(Examples based on 16-foot log
with 20-inch scaling diameter)

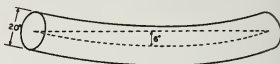Defect section (rule 1):
Percent deduction = $\dfrac{4}{16}$ = 25%

Defect sector (rule 2):
Percent deduction = $\left(\dfrac{6}{16}\right)\left(\dfrac{60}{360}\right)$

= 6¼%

Sweep (rule 3):
Percent deduction = $\dfrac{8-2}{20}$

= 30%

Crook (rule 4):
Percent deduction = $\dfrac{(10)}{20}\dfrac{(4)}{16}$ = 12½%
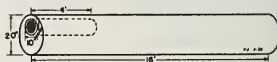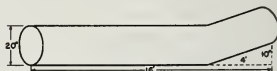
Interior defect (rule 5):
Percent deduction = $\dfrac{(8)(10)}{(20-1)^2}\left(\dfrac{4}{16}\right)$ = 5-5/9%

In practice each ellipse axis can be divided
by (20-1) and rounded to nearest tenth if
desired.

Thus $\dfrac{8}{19}$ = .4, $\dfrac{10}{19}$ = .5, and (.4)(.5)$\left(\dfrac{4}{16}\right)$ = 5%

Figure 1. — Aids for determining scaling deductions. From:
Grosenbaugh, L. R., SHORT CUTS FOR CRUISERS AND
SCALERS; U. S. Forest Service, South. Forest Experiment
Station. Occas. Paper 126, 1952.

## Table 1. TOTAL CUTTING LENGTHS FOR HARDWOOD LOG GRADES

| Log Length (feet) | Log Grade | | | | | |
|---|---|---|---|---|---|---|
| | 1 (5/6 yield) | | 2 (4/6 yield) | | 3 (1/2 yield) | |
| | Clear | Lose | Clear | Lose | Clear | Lose |
| 10 | 8'4'' | 1'8'' | 6'8'' | 3'4'' | 5' | 5' |
| 12 | 10' | 2' | 8' | 4' | 6' | 6' |
| 14 | 11'8'' | 2'4'' | 9'4'' | 4'8'' | 7' | 7' |
| 16 | 13'4'' | 2'8'' | 10'8'' | 5'4'' | 8' | 8' |

For No. 1 — Length times 2 gives inches can lose.
For No. 2 — Length times 4 gives inches can lose.

**Table 2.** — International decimal ¼-inch log rule

| D.i.b. (inches) | Length in feet | | | | |
|---|---|---|---|---|---|
| | 8 | 10 | 12 | 14 | 16 |
| 6 | 10 | 10 | 10 | 20 | 20 |
| 7 | 10 | 20 | 20 | 20 | 30 |
| 8 | 20 | 20 | 30 | 30 | 40 |
| 9 | 20 | 30 | 40 | 40 | 50 |
| 10 | 30 | 40 | 50 | 60 | 60 |
| 11 | 40 | 50 | 60 | 70 | 80 |
| 12 | 40 | 60 | 70 | 80 | 100 |
| 13 | 50 | 70 | 80 | 100 | 120 |
| 14 | 60 | 80 | 100 | 120 | 140 |
| 15 | 70 | 90 | 110 | 140 | 160 |
| 16 | 80 | 110 | 130 | 160 | 180 |
| 17 | 100 | 120 | 150 | 180 | 210 |
| 18 | 110 | 140 | 170 | 200 | 230 |
| 19 | 120 | 160 | 190 | 220 | 260 |
| 20 | 140 | 170 | 210 | 250 | 290 |
| 21 | 150 | 190 | 230 | 280 | 320 |
| 22 | 170 | 210 | 260 | 310 | 350 |
| 23 | 190 | 240 | 280 | 340 | 390 |
| 24 | 200 | 260 | 310 | 370 | 420 |
| 25 | 220 | 280 | 340 | 400 | 460 |
| 26 | 240 | 300 | 370 | 430 | 500 |
| 27 | 260 | 330 | 400 | 470 | 540 |
| 28 | 280 | 360 | 430 | 510 | 580 |
| 29 | 300 | 380 | 460 | 550 | 630 |
| 30 | 330 | 410 | 500 | 590 | 670 |

Computed from volume of 4-foot section for 1/8" sawkerf = $0.22D^2 - 0.71D$ and on assumed taper of 1/2 inch in 4 feet. Result multiplied by 0.905 to convert to 1/4" sawkerf. Computed by Northeastern Forest Experiment Station, 1951.

Table 3. — Doyle log rule, contents of logs in board feet

| Scaling diameter | Log length in feet | | | | |
|---|---|---|---|---|---|
| | 8 | 10 | 12 | 14 | 16 |
| In. | ........ Board feet ........... | | | | |
| 6* | 2 | 3 | 3 | 4 | 4 |
| 7* | 5 | 6 | 7 | 8 | 9 |
| 8 | 8 | 10 | 12 | 14 | 16 |
| 9 | 13 | 16 | 19 | 22 | 25 |
| 10 | 18 | 23 | 27 | 32 | 36 |
| 11 | 25 | 31 | 37 | 43 | 49 |
| 12 | 32 | 40 | 48 | 56 | 64 |
| 13 | 41 | 51 | 61 | 71 | 81 |
| 14 | 50 | 63 | 75 | 88 | 100 |
| 15 | 61 | 76 | 91 | 106 | 121 |
| 16 | 72 | 90 | 108 | 126 | 144 |
| 17 | 85 | 106 | 127 | 148 | 169 |
| 18 | 98 | 123 | 147 | 172 | 196 |
| 19 | 113 | 141 | 169 | 197 | 225 |
| 20 | 128 | 160 | 192 | 224 | 256 |
| 21 | 145 | 181 | 217 | 253 | 289 |
| 22 | 162 | 203 | 243 | 284 | 324 |
| 23 | 181 | 226 | 271 | 316 | 361 |
| 24 | 200 | 250 | 300 | 350 | 400 |
| 25 | 221 | 276 | 331 | 386 | 441 |
| 26 | 242 | 303 | 363 | 424 | 484 |
| 27 | 265 | 331 | 397 | 463 | 529 |
| 28 | 288 | 360 | 432 | 504 | 576 |
| 29 | 313 | 391 | 469 | 547 | 625 |
| 30 | 338 | 423 | 507 | 592 | 676 |

*It is common practice in the South to assign logs 8″ d.i.b. and under their length as the Doyle Scale of the log.

Table 4.
Scribner Decimal C log rule, contents of logs in board feet

| Scaling | Log length in feet | | | | |
|---|---|---|---|---|---|
| Diameter | 8 | 10 | 12 | 14 | 16 |
| In. | . . . . . . . . Board feet . . . . . . . . . . . . | | | | |
| 6 | 5 | 10 | 10 | 10 | 20 |
| 7 | 10 | 10 | 20 | 20 | 30 |
| 8 | 10 | 20 | 20 | 20 | 30 |
| 9 | 20 | 30 | 30 | 30 | 40 |
| 10 | 30 | 30 | 30 | 40 | 60 |
| 11 | 30 | 40 | 40 | 50 | 70 |
| 12 | 40 | 50 | 60 | 70 | 80 |
| 13 | 50 | 60 | 70 | 80 | 100 |
| 14 | 60 | 70 | 90 | 100 | 110 |
| 15 | 70 | 90 | 110 | 120 | 140 |
| 16 | 80 | 100 | 120 | 140 | 160 |
| 17 | 90 | 120 | 140 | 160 | 180 |
| 18 | 110 | 130 | 160 | 190 | 210 |
| 19 | 120 | 150 | 180 | 210 | 240 |
| 20 | 140 | 170 | 210 | 240 | 280 |
| 21 | 150 | 190 | 230 | 270 | 300 |
| 22 | 170 | 210 | 250 | 290 | 330 |
| 23 | 190 | 230 | 280 | 330 | 380 |
| 24 | 210 | 250 | 300 | 350 | 400 |
| 25 | 230 | 290 | 340 | 400 | 460 |
| 26 | 250 | 310 | 370 | 440 | 500 |
| 27 | 270 | 340 | 410 | 480 | 550 |
| 28 | 290 | 360 | 440 | 510 | 580 |
| 29 | 310 | 380 | 460 | 530 | 610 |
| 30 | 330 | 410 | 490 | 570 | 660 |